

Materials for a Monograph of Freycinetia (Pandanaeae). I.

by

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The following notes represent the results of studies in the genus *Freycinetia*, a large and somewhat neglected group of plants with perhaps as many as two hundred species. Previous studies in the group have appeared by the present author in the form of a review of the species of the Solomon Islands (*Proc. Biol. Soc. Wash.* 76: 1-8. 1963), a proposed new species from Morotai, Moluccas Is. (*Journ. Arn. Arb.* 43: 248-350. 1962), and a review of the species known from Fiji, Samoa, and Tonga (*Proc. Biol. Soc. Wash.*, 80: 47-60. 1967). The work here reported concerns species of Polynesia, Micronesia, Melanesia, and Malaysia, and consists chiefly of some shorter studies in particular species, some nomenclatural adjustments, some reports of recent collections, and the description of a few new taxa. Because it is proposed to initiate further publications in this series, paragraphs or sections are numbered for ready future reference.

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1.1. The typification of the genus *Freycinetia* and remarks on the Hawaiian species.

The genus *Freycinetia* was established by Gaudichaud (*Bot. Voy. Freycinet . . . l'Uranie et Physicienne . . . Atlas*, t. 41. 1826), with three species: *F. arborea*, *F. scandens*, and *F. radicans*. The first of these is selected as generitype. It is represented by a collection made by Gaudichaud in Hawaii, and is well figured in the table referred to above. *Freycinetia scandens* Gaud., a valid species, is from Timor (the holotype is Zollinger 647), and *F. radicans* is from Rawak, New Guinea (the holotype a Gaudichaud specimen).

Freycinetia arborea Gaud. is the only species occurring in the Hawaiian Archipelago. However, in Hillebrand's *Flora of the Hawaiian Islands* (1888: 453) the species is described under the name "*Freycinetia Arnotti* Gaudich." This was proposed by Gaudichaud in a later publication, of 1843 (*Bot. Voy. La Bonite*, Atlas t. 36, 37), and was taken up by some later authors. It is however nothing more than a slightly differing specimen of the single widely distributed species in the Hawaiian group. The alleged distinction, based on the number of stigmas per berry, is unnatural; stigmatic number varies in this species generally, from 4 to 10 (or more), and the supposedly distinctive ranges ("4-6" in *F. Arnotti*, "6-9" in *F. arborea*) are mere samplings of the inclusive range.

Hillebrand was aware that but a single species was to be found in the Hawaiian flora, but he took up the latter name *F. Arnotti* because "the older name *F. arborea* has to be abandoned as inappropriate and misleading." He was right in saying that the older name was inappropriate, as the species is a woody climber, as are all other known species of the genus, but with regard to the choice of name we are retroactively required to use the earlier name.

Freycinetia arborea Gaud., in Freyc. Voy. Uranie et Physicienne, Bot., Atlas t. 41. 1826. Solms-Laubach, Linnaea n.s. 8: 100. 1878-79. Mann, Enum. Haw. Plts. n. 469. 1866. [Fig I: 1.]

F. scandens sensu Hooker & Arnott, Bot. Beechey Voy. 87. 141. (non Gaudichaud).

F. arnotti Gaud., Bot. Voy. Bonite, Atlas t. 36, 37. 1843.

F. arnotti Gaud., Bot. Voy. Bonite, Atlas t. 36, 37. 1843. Solms-Laubach, Linnaea n.s. 8: 95. 1878-79. Hillebrand, Fl. Haw. Is. 453. 1888.

Holotype: HAWAIIAN ISLANDS: "In insulis Sandwich" (Gaudichaud). PARIS; and isotype in the Delessert Herbarium (GENEVA). The holotype of *F. Arnotti* is also marked simply "In insulis Sandwich" (Gaudichaud).

Occurrence: A common species throughout the six major islands of the Hawaiian Archipelago (Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii). It does not occur on the dry barren island of Kahoolawe, nor on the tiny crescentic rim Molokini. It apparently does not occur on the island of Niihau (neither Forbes, in his Enumeration of Niihau Plants of 1913, nor St. John, in his paper on Niihau plants in 1959, records the species). It is not known from the Leeward Islands of the Hawaiian group (Nihoa, Necker, Laysan, Lisiansky, Midway and Kure).

Habitat: *Freycinetia arborea* is most abundant in the lower and middle forest zones (of Rock, 1913) or Vegetation Zones B, C, and D (of Ripperton and Hosaka, 1942), where it may be found climbing by its clinging roots on forest trees, or sometimes with the loose stems falling and intermingling to form dense clumps of what appears to be terrestrial growth especially on steep slopes. It roots in old lava soils, either rocky or in rich loam. The largest

plants are found in moderate shade, but they tolerate windswept exposed conditions on cliffs as well. In general, *Freycinetia arborea* can be considered a rather common species between about 300 meters and about 1500 meters altitude.

Some recent collections of *F. arborea*:

HAWAIIAN ISLANDS: Kauai: Summit of Mt. Haupū, S.E. side at 700 m alt., Dec. 1956, *Stone* 1645 (BISHOP, K, US); Oahu: Puulūpe, Kawailoa, Feb. 1937, *Degener, Topping, Martinez & Salucop* 11070 (US); Waimano, Oct. 1935, *Degener, Park & Shigeura* 10140 (US); Piko trail, Mokuleia, *Yuncker* 3316 (US); Punaluu, Castle Trail, *Stone* 1166 (BISHOP); Manoa Cliff Trail, *Stone* 3109 (BISHOP); Pupukea, Sept. 1958, *Stone* s.n. (BISHOP); Maui: Puu Mukui, Sept. 1916, *Hitchcock* 14777 (US); without locality, April 1911, *Curran* 83 (US); Hawaii: Volcano Road, July 1924, *Setchell* s.n. (US); Honaunau Mountains, Sept. 1916, *Hitchcock* 14561 (US).

An illustration of the berry and seed is provided (Fig. I).

1.2. ***Freycinetia kiekie*** B. C. Stone, nom. nov.

F. monticola F. B. H. Brown, Bishop Mus. Bull. 84: 29. pl. 19. 1931; not *F. monticola* Rendle, Journ. Linn. Soc. Bot. 45: 259. 1921.

Type locality: French Oceania: Marquesas Islands: Hivaoa Island, Feani, *F. Brown* 870 (BISHOP).

This endemic species is also reported from Uapou Island on the basis of *Quayle* 1135. It is quite distinct from Rendle's species; rather it is related to the above Hawaiian *F. arborea*. The new name is taken from the Marquesan version of the widespread Polynesian name for this genus. Subject to the normal changes (as in glottal stops) the same word is used throughout Polynesia. In Hawaii, it is 'ie'ie.

1.3. ***Freycinetia distigmata*** B. C. Stone, nom. nov.

F. klossii Ridley in Kew Bull. 1926: 92. 1926; not *F. Klossii* Ridley in Trans. Linn. Soc. Bot. 9: 236. 1916.

Type locality: Sumatra: Mentawi Island; Siberut, *Boden-Kloss* 14547.

Ridley inadvertently used the same epithet twice in the genus in honor of Boden-Kloss. The species first so named, and to which the name continues to apply, is from New Guinea. The Sumatran species requires a new name, given above in reference to its generally 2-stigmatic carpels.

1.4. ***Freycinetia* collected in New Guinea in 1959 by L. J. Brass.**

During a year spent at the U. S. National Herbarium (Smithsonian Institution, Washington D.C.), I had the opportunity of studying the collections of *Freycinetia* made by Leonard J. Brass in 1959, during the Fifth Archbold Expedition, sponsored by the American Museum of Natural History with the aid of a grant from the National Science Foundation. As is well known, the series of

Archbold Expeditions have been invaluable in increasing our knowledge of New Guinea, and Mr. Brass's collections are generally exemplary in quality. In fact, a large number of species of Pandanaceae are based on Brass specimens.

The following account details collection data of species collected, and includes the descriptions of two proposed new species of *Freycinetia* based on Mr. Brass's material. The text may be considered as a continuation of the papers by Merrill and Perry on previous Pandanaceae from New Guinea, which appeared in *Journ. Arn. Arb.* 20: 139–186. 1939; and 21: 163–175. 1940. I am grateful to Dr. Lily M. Perry for her kind assistance during a visit to the Harvard University Herbaria in 1961, and also to Dr. Richard A. Howard, Director of the Arnold Arboretum.

Section *Freycinetia*¹

In the interest of convenience there are included here a few nomenclatural adjustments.

1. *Freycinetia funicularis* (Savigny) Merr., Interpret. Rumph. Herb. Amb. 83. 1917; Merr. & Perry, *Journ. Arn. Arb.* 20: 155. 1939; 21: 168. 1940. [Fig. I: 2.]

Freycinetia strobilacea Bl. in Rumphia 1: 156. t. 39. 1835; Schnizlein, Icon. 1: t. 74, f. 3–5. 1846; Solms-Laubach, Ann. Jard. Bot. Buitenz. 3: 99. 1883; Warb. in Pflanzenr. 3 (IV. 9): 34. 1900; Martelli, Webbia 3: 315. 1910.

Freycinetia cyrtocarpa Kanehira, Bot. Mag. Tokyo 55: 295. f. 13. 1941. Syn. nov.

Type locality: Amboina. Recorded from the Solomon Islands by Merrill & Perry. The type of *F. strobilacea* is the Rumphian plate, on which is based the correct name taken up by Merrill.

The type of Kanehira's species is from "Netherlands New Guinea (Boemi, about 40 km inland from Geelvink Bay, at about 300 m alt., *Kanehira & Hatusima* 12680)". Although this species may be distinct, (we are less than certain of all details of the plant pictured by Rumphius) it seems to be synonymous. The few differences are the smaller, nearly smooth leaves, the unarmed bracts, and the slightly curving syncarps; but these do not carry much significance.

NEW GUINEA: Papua: Northern District, near Koreaf, Tuji subdistrict, 23 September 1954, *Hoogland* 4794 (A); near Budi Barracks, "urur" in Onjob language, 25 August 1954, *Hoogland* 4552 (A, US); Morobe District, Sattelberg, 1000 m alt., 8 Nov. 1935, *Clemens* 832 (A). Finschhafen Peninsula, in beach woods, 19 October 1936, *Clemens* 4286 (A).

¹ Article 22 of the International Code of Botanical Nomenclature requires that the name of the section that includes the type species of a genus repeat that name unaltered as its epithet. Consequently Sect. *Freycinetia* must be used for the section including *F. arborea* Gaud., rather than the earlier proposed Sect. *Pleostigma* Warb. in Pflanzenr. 3 (IV. 9): 28. 1900. This section is characterized by berries with mostly 5–10 stigmas.

Both Hoogland and Clemens note that the bracts are "deep red" or "flame color". Solomon Islands specimens collected by L. J. Brass were, according to Brass's field data, characterized by "pink bracts." These specimens have also the much less conspicuously dentate vegetative bracts which Kanehira mentions for his *F. cyrtocarpa*.

2. ***Freycinetia salamauensis*** Merr. & Perry, Journ. Arn. Arb. 20: 152. pl. 1, f. 7. 1939. [Fig. I: 3.]

Type locality: North-eastern New Guinea, Morobe District, Sattelberg, Salamaua (*Clemens* 28, A).

This species appears to be very close to *F. biroi* Warb. The authors distinguished it by its shorter common peduncle, longer pedicels, and the hispidulous angles and apex of the pedicels. It is one of the species which is intermediate between the generic sections, having for the most part berries with 3 stigmas; the range is from 2 to 6 stigmas per berry.

NEW GUINEA: Eastern Highlands District, Kassam Gap, 1460 m alt., 28 Oct. 1959, climbing to middle spaces in Castanopsis-oak forest; leaves glaucous on both sides; ripening fruits orange-red, *Brass* 32285 (US, and to be distrib.).

3. ***Freycinetia sogerensis*** Rendle, Journ. Bot. 61. Suppl. 58. 1923.

Type locality: "New Guinea, Sogere, 2,500 ft." (*Forbes* 75).

NEW GUINEA: Eastern Highlands District, Purosa, Okapa area, 150 m alt., common root-climber on exposed tree-trunks in rainforest; ripe fruiting heads orange, soft, ovoid, avg. 3.5 cm long, 2.5 cm broad, 2 October 1959, *Brass* 31851 (US, and distrib.).

4. ***Freycinetia stenodonta*** Merr. & Perry, Journ. Arn. Arb. 20: 151. 1939.

Type locality: Papua, Central Division, Ononge Road, Dieni (*Brass* 3838).

NEW GUINEA: Morobe District, Gurakor, 640 m alt., climbing to 3 m in oak-dipterocarp forest, flat leaves appressed to supporting trunk, sterile, 6 May 1959, *Brass* 29452 (US); Sattelberg, 3200 ft. alt., *Clemens* 862i-bis (A).

A readily recognizable species, with marked vegetative characters. The syncarps of the Clemens specimen are shortly oblong, and they are noted as "red, fleshy."

5. ***Freycinetia perryana*** B. C. Stone, sp. nov. (Sect. *Freycinetia*). [Fig. I: 4.]

Scandens; caule lignoso subrobusto ad 1 cm crasso; foliis ensiformibus basi imbricatis 39–47 cm longis, 16–18 mm latis, apice anguste acuminatis, basi vix angustatis, amplexicaulibus. margine basim et apicem versus et costa media in parte superiore serrato-dentatis; auriculis scarioso-membranaceis, circiter 8–9 cm longis, 8–9 mm latis, margine integerrimis, in parte superiore decurrentibus (vel rotundatis?) adnatis, demum transverse fractis; inflorescentia terminalia, spathis caducis non visis, pedicellis 5–6.5 cm longis ad 4 mm crassis, ubique denticulis crassis deltoideis

erectis 0.3–0.6 mm longis et latis armatis, pedicello apicem versus subdense scabridis; syncarpiis 5, cylindraceis, circiter 8 cm longis, et 1.7 cm latis; baccis circiter 9 mm longis et 3 mm latis, infra 4/5 carnosae apice coriaceis truncatis angulosis, areola stigmatica pallide brunnea nitente annulos cinctos kermesinos, stigmatibus vulgo 2 vel 4 rarius 5; fissuris stigmaticis angustis conspicuis; seminibus anguste semi-ellipsoideis usque ad 1.5–1.7 mm longis, fusco-rubris, raphide cum cellulis raphidophoris argenteis niten- tibus, strophiole nullo.

Holotype: NEW GUINEA: Eastern Highlands District, Mt. Wilhelm, eastern slopes, 2770 m alt., 29 July 1959, L. J. Brass 30765 (US, and isotypes for distrib.).

This species is similar to *Freycinetia trachypoda* Merr. & Perry and also to *F. tafaensis* Merr. & Perry; differing however from the former in having smaller leaves, coarsely scabrid (rather than hispidulous) pedicels, and more numerous syncarps; and from the latter in having somewhat longer leaves with apically narrowed, entire auricles (rather than truncate, spinulose auricles), longer more coarsely scabrid pedicels (to 6.5 cm long, rather than only 1.5 cm long), and larger more numerous syncarps per inflorescence.

It is a pleasure to dedicate the species to Dr. Lily M. Perry, long an associate and colleague of Dr. E. D. Merrill, long associated with the Arnold Arboretum, and well-known for numerous studies on Melanesian plants.

Section *Oligostigma* Warb.

6. *Freycinetia angustissima* Ridley, Journ. Bot. 24: 359. 1886; Martelli, Webbia 3: 309; 1910; Rendle, Journ. Bot. 61. Suppl. 57. 1923; Kanehira, Bot. Tokyo 55: 251. f. 1. 1941; Merr. & Perry, Journ. Arn. Arb. 21: 163. 1940.

Freycinetia stenophylla Warb. in K. Schum. & Lauterb. Fl. Deutsch. Schütze. i. d. Südsee, Nachtr. 53. 1905; Martelli, Webbia 3: 315. 1910; Journ. Arn. Arb. 10: 137. 1929; White, Journ. Arn. Arb. 10: 201. 1929; Merr. & Perry, Journ. Arn. Arb. 20: 141. 1939.

F. sp. Solms-Laubach, Jard. Bot. Buitenz. Bull. 3: 101. 1883.

Freycinetia polyclada Merr. & Perry, Journ. Arn. Arb. 20: 141. pl. 1, f. 3. 1939.

Type locality: New Guinea, Sogere, 2000 ft. (*Forbes*).

The type of *Freycinetia stenophylla* was from the Torricelli Mountains, Kaiser-Wilhelmsland, 600 m alt. (*Schlechter* 14525); and that of *F. polyclada* was from North-eastern New Guinea, Central Division, Mount Tafa, 2400 m alt. (*Brass* 4961). The latter species was synonymized by Merrill and Perry in their second paper of 1940 on New Guinea Pandanaceae (Journ. Arn. Arb. 21).

NEW GUINEA: Eastern Highlands District, Mt. Otto, south slopes, 2200 m alt., common in disturbed forest, climbing to 7 m not much branched; fruit-heads usually solitary, sometimes 2 or 3, ovoid or subglobose, orange, about 2.5 cm in diameter when ripe; 14 Aug. 1959, *Brass* 31050 (US and distrib.); same loc., 2680 m alt., plentiful in mossy beech forest, 7 August 1959, *Brass*

30874 (US, unicate). Papua: Boridi, in forest, fruit to 2 cm long, 16 September 1935, *Carr* 13182 (A, BM). Morobe District; Sattelberg, 12 May 1938, *Clemens* 8221 (A).

7. ***Freycinetia archboldiana*** Merr. & Perry, Journ. Arn. Arb. 20: 147. pl. 1, f. 10. 1939.

Freycinetia inouei Kanehira, Bot. Mag. Tokyo 55: 254. f. 4. 1941. Syn. nov.

Type locality: Papua, Central Division, Bella Vista (*Brass* 5458).

The type of *Freycinetia inouei* Kaneh. was from Dallmann in then Netherlands New Guinea (*Kanehira* & *Hatusima* 12163). Kanehira stated that the species is distinguished from *F. archboldiana* by its "much thicker syncarp and more numerous drupes" (sic; i.e. berries), but these differences seem more due to individual variation than to a species difference. A comparison of an isotype (A) with the type of *F. archboldiana* (also at A) failed to reveal any further differences of significance.

Kanehira mentions that the leaves are rigid, erect, and tinged purplish when fresh. The seeds show a conspicuous raphe but lack a strophiole.

8. ***Freycinetia arfakiana*** Martelli, *Webbia* 3: 173. 1910.

Type locality: "Netherlands New Guinea, Mt. Arfak, Putat" (*Beccari* 821).

NEW GUINEA: Eastern Highlands District; Arau, 1400 m alt., frequent in castanopsis-oak forest, climbing to several meters and sparingly branched, bracts white with pale green tips, 14 Oct. 1959, *Brass* 32070 (US and distrib.).

This specimen is referred here with some hesitation; the leaves are mostly 25–29 cm long and 4–4.5 cm broad (shorter than those of *Beccari*'s type by 10–15 cm), entire, with auricles 5–6 cm long and 8–9 mm broad, these entire and deciduous; syncarps terminal, narrowly cylindric, on smooth pedicels 2–3 cm long, about 3 mm thick, four in number, each syncarp to 3 cm long and 9 mm thick; berries with mostly 2–4 stigmas but very immature.

9. ***Freycinetia brassii*** Merr. & Perry, Journ. Arn. Arb. 20: 145. 1939. [Fig. I: 6.]

Type locality: Papua, Fly River, 528 Mile Camp (*Brass* 6651).

NEW GUINEA: Morobe District; Gurakor, 640 m alt., scrambling to 10 meters in rainforest, 5 May 1959, *Brass* 29431 (US, unicate).

This specimen matches the original description well except that the inflorescence is lateral (i.e. pseudo-lateral). Since this is a variable character, (sometimes both terminal and 'lateral' inflorescences occur on the same plant), and the other features correspond so closely, there is no apparent reason for keeping it distinct. It should be remarked that *Freycinetia lacinulata* Kanehira is scarcely to be distinguished from *F. brassii*. Kanehira stated that the differences lie in the ellipsoid, rather than oblong-cylindric

syncarps of the former, and the brownish to orange-red color of the berries; these differences are however unimportant. Brass's notes mention that the syncarps of his no. 6657 (cited by Merrill and Perry under *F. brassii*) were orange-red; while those of his no. 6927 were brown.

10. ***Freycinetia crucigera*** Kanehira, Bot. Mag. Tokyo 55: 252. 1941.

Type locality: "Netherlands New Guinea; Dallmann, 600 m alt." (*Kanehira & Hatusima* 12286).

NEW GUINEA: Eastern Highlands District; Mt. Michael, north-eastern slopes 2000 m alt., climbing to 2 meters in castanopsis-oak-nothofagus forest; fruits immature; seeds purple; 9 September 1959, *Brass* 31471 (US); Purosa, Okapa area, 1950 m alt., frequent in mixed rainforest, climbing to several meters, leaves thin and crinkled, flowering bracts green, fruits unripe, 20 September 1959, *Brass* 31593 (US).

The first specimen cited fits the original description and figure very well, except for the terminal infructescence; and the second specimen bears smaller leaves, but of the same proportions, and the infructescence is either lateral or terminal, indicating this character's variability. The principal difference between this species and *Freycinetia beccarii* seems to be the relatively broader leaves and the seeds without strophiole, of the present species.

11. ***Freycinetia fibrosa*** Martelli, Journ. Arn. Arb. 10: 138. 1929; Merr. & Perry, *ibid.* 21: 164. 1940.

F. sogerensis sensu Merr. & Perry, loc. cit. 20: 147. 1939, non Rendle 1923.

Type locality: Papua; Gulf District, Vailala River, Hokoro, 100 m alt. (*Brass* 1048).

NEW GUINEA: Eastern Highlands District; Mt. Elandora, Kratke Mts., 2130 m alt., climbing on forest undergrowth, fruits immature; 18 Oct. 1959, *Brass & J. D. Collins* 32164 (US); Purosa, Okapa Area, 1950 m alt., climbing to 10 meters in rainforest, common, flowering bracts thin, greenish-white; 21 September 1959, *Brass* 31632 (US).

13. ***Freycinetia kanehirae*** B. C. Stone, nom. nov.

Freycinetia platyphylla Kanehira, Bot. Mag. Tokyo 55: 261. f. 10. 1941; not *F. platyphylla* Merrill, Philipp. Journ. Sci. Bot. 13: 267. 1918.

Type locality: "Netherlands New Guinea: Dallman-Patema, 600 m alt.;" (*Kanehira & Hatusima* 12285).

The required new name commemorates Professor Ryoza Kanehira, formerly of the Department of Agriculture of the Kyushu Imperial University in Fukuoka, Japan, a student of the Pandanaceae and authority on the flora of Micronesia. There is also a *Pandanus kanehirae* Martelli from Palau. Merrill's species is from the Philippines.

Freycinetia kanehirae is characterized by its very large leaves (120 cm long, 7–8 cm broad), its large cylindric syncarps of numerous slender berries, and its smooth fruit-pedicels. It is reminiscent of *F. tessellata* Merr. & Perry of the Solomon Islands, but differs in its smooth rather than scabrid pedicels; and of *F. ponapensis* Martelli of Ponape (Caroline Islands), but differs in the obtuse leaf tips and much longer syncarps.

14. ***Freycinetia radicans*** Gaudich., in Freycinet, Voy. autour du Monde... sur les corvettes l'Uranie et le Physicienne... Bot. 432; et Atlas Bot. t. 43. 1826; emend. Warb. in Pflanzenr. 3 (IV. 9): 34. 1900. [Fig. I: 5.]

Type locality: Is. Rawak, near West Irian (West New Guinea). The type is Gaudichaud's collection.

NEW GUINEA: Morobe District; Kaindi, 2250 m alt., occasional in Nothofagus forest, scandent to 20 meters or more; 10 May 1959, Brass 29666 (US).

This species is imperfectly known; but the Brass collection corresponds with what little is known.

15. ***Freycinetia spinellosa*** Kanehira, Bot. Mag. Tokyo 55: 265. f. 12. 1941.

Type locality: "Netherlands New Guinea: Dallmann (*Kanehira* & *Hatusima* 12507).

NEW GUINEA: North-western New Guinea: Sorong, Kp. Baroe, in forest, nom. vern. "riligino", 28 July 1948, *Djamhari* 389 (A).

A species notable for its long narrow leaves and spinulose-margined auricles.

16. ***Freycinetia tafaensis*** Merr. & Perry, Journ. Arn. Arb. 20: 146. 1939.

Type locality: Papua: Central Division, Mt. Tafa, 2400 m alt.; (Brass 5001).

NEW GUINEA: Eastern Highlands District, Mt. Elandora, Kratke Mts., 2530 m alt., scrambling to 1.5 meters in scrubby growth of summit, flower bracts orange; 18 Oct. 1959, Brass and Collins 32144 (US). Morobe District, Mt. Kaindi, 2200 m alt., frequent in Nothofagus forest, climbing to 12 meters, branches spreading, flower bracts orange-yellow; 23 May 1959, Brass 29733. (US).

17. ***Freycinetia elegantula*** B. C. Stone, sp. nov. (Sect. Oligostigma). [Fig. I: 7.]

Liana nana ad arbores adpressa, caulis lignosis, 2–6 mm diametro, laevis, in sicco rugulosus; ramis angustis, radicibus fibrosis emittens; folia minima, ovata, 15–22 mm longa, 5–9 mm lata, acuta, longitudine nervosa (nervis utrinque circiter 8) margine et in costa dorsale spinulosa vel fimbriatula (spinulis 1–1.3 vel 2 mm longis et 1–2 per mm); auriculis caducis minutis inconspicuis amplexantibus; inflorescentia lateral, caule brevis (8–10 mm longo) bracteato

terminans; bracteis caulae basin versus deltoideis acuminatis margine integerrimis; bracteis caulae apicem versus foliaceis; bracteis floraleis viridis margine integerrimis; pedicellis 3, apicem versus minute et persparse breve-spinulosis vel sublaevibus, 5–7 mm longis; syncarpiis 3, subglobosis, ad 12 mm diametro; baccis carnosis, circiter 4 mm longis, 1.5–3 mm latis, apice rotundatis; stigmatibus 1–2; seminibus anguste semi-ovatis, circiter 0.7 mm longis, strophiole nullo (?).

Holotype: NEW GUINEA: Eastern Highlands District, Arau, 1400 m alt., 8 October 1959, *L. J. Brass* 31945 (US, and isotypes for distrib.).

An extraordinary, tiny and elegant species related to *Freycinetia beccarii* but with smaller yet proportionately broader leaves with conspicuously spinulose margins and costa.

From the available material, which is without flowering or fruiting spikes, I judge this species to be the same or very nearly the same as that described in English only in 1939 by A. D. E. Elmer under the name *Freycinetia brevifolia* (*Leaf. Philipp. Bot.* 10: 3771. 1939). This name is invalid, since it is without a Latin diagnosis and printed after 1935; it is also a later homonym, since there is the earlier valid name *Freycinetia brevifolia* Martelli (*Webbia* 3: 186. 1910). Elmer's sole collection was from Camp Lambi, Nueva Ecija Province, Luzon. The leaves are described as 25 mm long, 20 mm broad, ovate-elliptic, and "margine serratuli-spinulosis, supra distincte nervatis". This corresponds very closely to the above description of *Freycinetia elegantula* except in the greater width. It is possible that but a single species is concerned, occurring both in New Guinea and the Philippines.

FIGURE I

Details of features of some species of *Freycinetia*.

1. *Freycinetia arborea*. Berry in profile and top view, x 5; seed x 5, and enlarged x 20. (From *Stone* 3109).
2. *Freycinetia funicularis*. Staminate plant; stamens x 5; male inflorescence x $\frac{1}{2}$; leaf apex x $\frac{1}{2}$. (From *Hoogland* 4552).
3. *Freycinetia salamauensis*. Berry in profile and top view x 5; seed enlarged x 20; portion of cellular structure of strophiole, greatly enlarged. The embryo is 0.2 mm thick; endosperm dark pink; seed walls crimson, 0.05 mm thick; raphe and strophiole translucent. (From *Brass* 32285).
4. *Freycinetia perryana*. Berry in profile and top view x 5; seed, two views, x 5. (From holotype, *Brass* 30765).
5. *Freycinetia radicans*. Berry in profile and top view x 5. (From *Brass* 29666).
6. *Freycinetia brassii*. Berry in profile and top view x 5; leaf apex x $\frac{1}{2}$. (From *Brass* 29431).
7. *Freycinetia elegantula*. Berry in profile and top view x 5; seed x 5; leaf x 1; and infructescence x 1. (From holotype, *Brass* 31945).

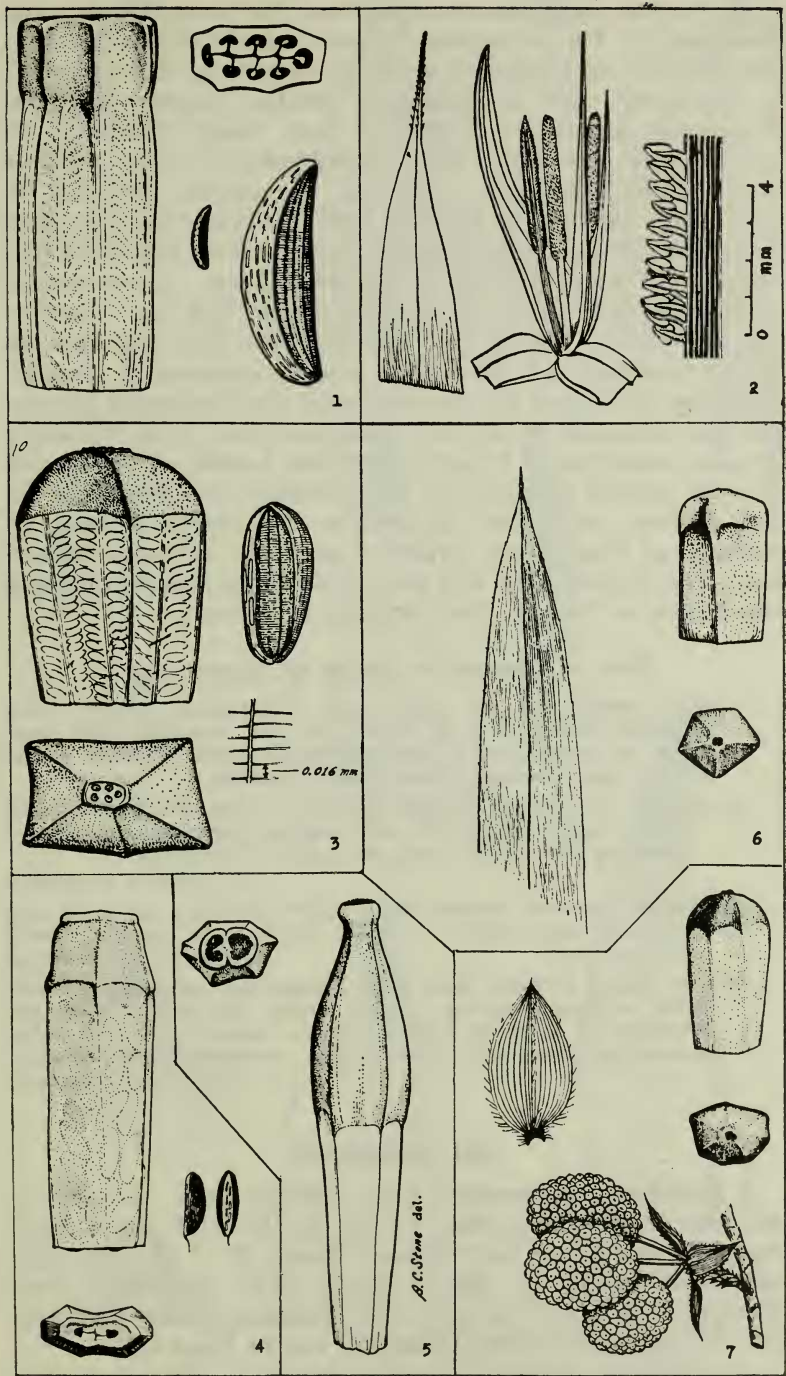


FIGURE I

See caption on page 10

1.5. The genus *Freycinetia* in Micronesia.

Four species have been recorded from Micronesia (Caroline and Marianne Is.), but the number is here reduced to three, based on the reduction of Kanehira's proposed *Freycinetia almonoguiensis* to synonymy with *F. villalobosii* Martelli emend. St. John. *Freycinetia ponapensis* Martelli is very closely similar to *F. mariannensis* but after long consideration I here maintain their specific difference. However, Kanehira's proposed *F. carolinensis* of Palau is identical with *F. mariannensis* (not with *F. ponapensis*, as Kanehira himself later decided). Hosokawa described the Ponape plants as *F. mariannensis* var. *microsyncarpia*, while reducing *F. ponapensis* to the synonymy of *F. mariannensis*: but he indicated (*Journ. Jap. Bot.* 13: 191. 1937) that both his newly described and the typical varieties occurred in Ponape; while only the typical var. (*mariannensis*) was elsewhere in Micronesia. His discussion of the leaf tessellations, said to be distinctive as a taxonomic feature by both Merrill and Kanehira, discloses that it is too variable a feature for any taxonomic use. Hosokawa did not, however, investigate the auricles, leaf spectrum, seeds, or pedicels, all characteristic structures of major taxonomic importance. The following key will show some of the specific character correlations of the taxa here regarded as species:

Key to Micronesian species of *Freycinetia*

1. Stigmas mostly 1–3 per berry (Sect. *Oligostigma*); leaves thick coriaceous, mostly 3–5 cm broad, the apex acuminate with some degree of negative or concave curvature; auricles rounded gradually at apex, unarmed; syncarps stout cylindric.
Freycinetia ponapensis
2. Pedicels of syncarps sparsely scabrid at their distal ends; seeds nearly straight, about 1.3 mm long, the raphe scarcely or not exceeding the embryo; syncarps mostly 6–7 cm long.
Freycinetia mariannensis
2. Pedicels glabrous, smooth; seeds slightly lunulate, about 1.7 mm long, the raphe slightly exceeding the embryo; syncarps usually 8–9 cm long.
Freycinetia villalobosii
1. Stigmas mostly 3–10 per berry (Sect. *Freycinetia*); leaves rather thinly brittle coriaceous, mostly 1–3 cm broad, the apex tapered, not acuminate, to a narrow swordlike point; auricles abruptly rounded at apex and there with a few prickles; syncarps slender cylindric.
Freycinetia villalobosii

Sect. *Oligostigma*

1. *Freycinetia mariannensis* Merr., Philipp. Journ. Sci. Bot. 9: 48. 1941; Kanehira, Bot. Mag. Tokyo, 49: 185. 1935; Journ. Dept. Agric. Kyushu Imper. Univ. (Enum. Micron. Pl.) 4 (6): 259. 1935; Bot. Mag. Tokyo 51: 906, f. 62–63. 1937; Hosokawa, Bull. Biogeogr. Soc. Jap. 5 (2): 132. 1934; Glassman, Journ. Arn. Arb. 29: 178, in obs. 1948. [Fig. II and III: 1–4, Pl. I and II]

Freycinetia carolinensis Kanehira, Bot. Mag. Tokyo 49: 185. f. 17. 1935; Journ. Dept. Agric. Kyushu Imper. Univ. (Enum. Micron. Pl.) 4 (6): 259. 1935; Bot. Mag. Tokyo 51: 906. in synon. 1937.

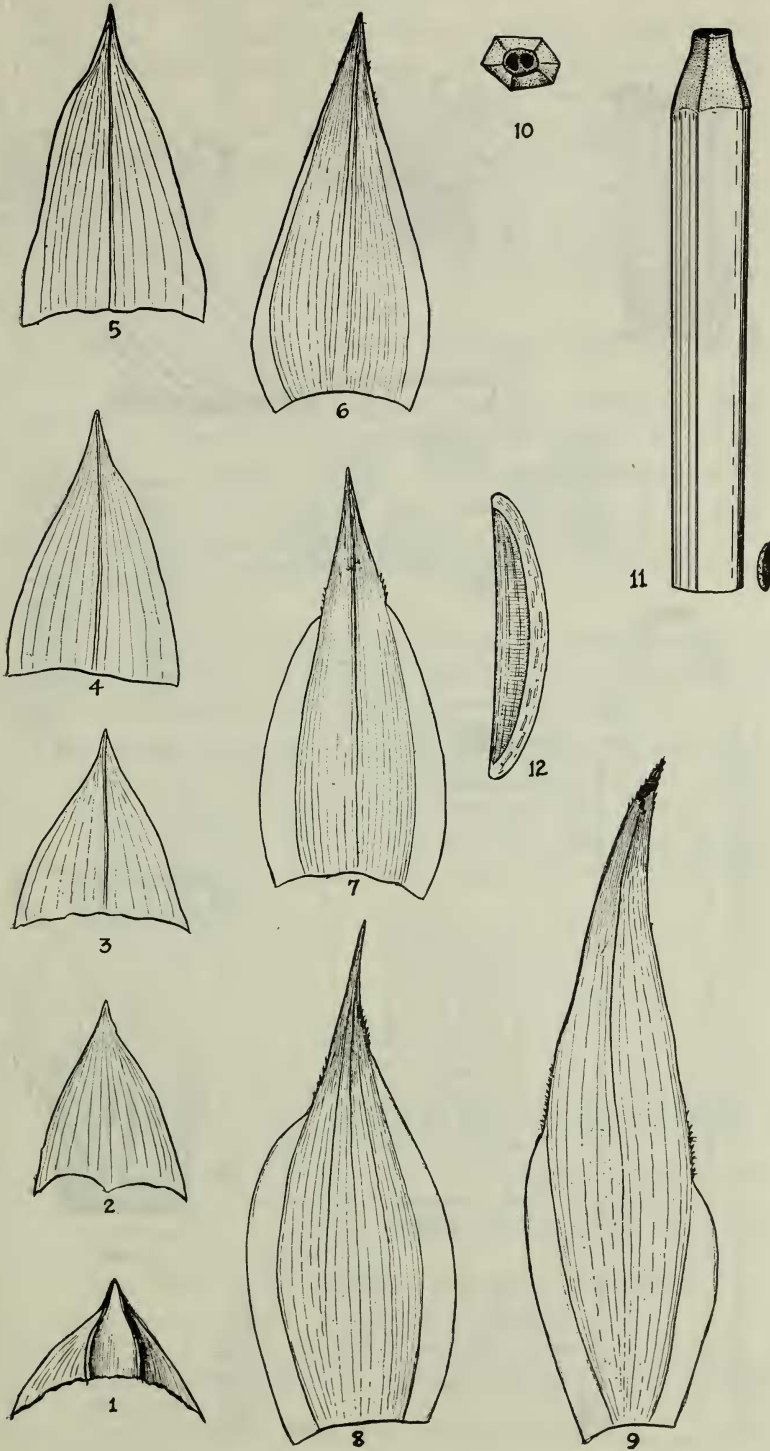


FIGURE II.

Freycinetia mariannensis. 1-9: 'leaf spectrum' from first vegetative bract (prophyll) to first foliage leaf (9). 10: berry in top view. 11: berry in profile x 5. 12: seed, x 20. 1-9, from Guam, Stone 4492; 10-12, from Palau, Kanehira 2359).

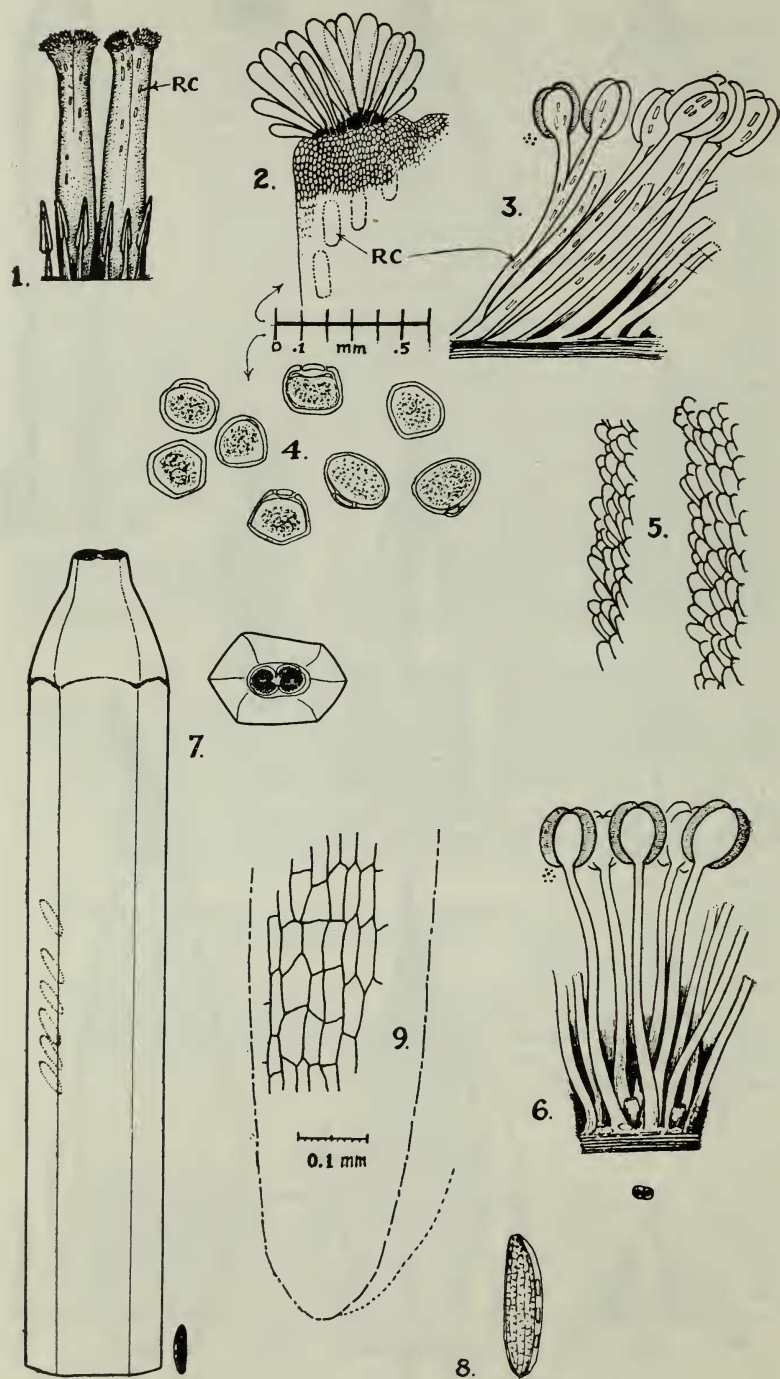


FIGURE III

Type locality: Guam, Marianas Is.

Distribution: Marianas Islands, Caroline Islands (Palau, Truk).

GUAM: North of Yona, *Rodin* 577 (US); 1.5 miles north-west of Yona, *Rodin* 759 (US); 2 miles S. of North-West Field, *Steere* 12 (US); between Agana and North-West Field, *Steere* 15 (US); Mt. Alifan, *Bryan* 1207 (BISHOP, US); Mt. Almagosa, *Hosaka* 3173 (BISHOP, US); Talofoto Valley, *Stone* 3970, 3971 (BISHOP, GUAM, L, US); Agat hills, *Stone* 4217 (BISHOP, GUAM, L, US); Fena River, *Stone* 4491, 4492 (BISHOP, GUAM, L, US); Guam, without locality, *Costenoble* (US, isosyntype); *Moore* 291 (US).

ROTA: Sabana, high plateau, in forest, *Stone* 5206a, b (GUAM); Feb. 1941, *Tuyama* s.n. (TOKYO).

SAIPAN: April 1930, *Shizuwo Momose* (TOKYO). (For previous collections see also Kanehira, Enum. Micron. Pl. 1935).

The seeds are slightly lunulate, or sometimes straight, about 1.6–1.7 mm long, and 0.25–0.37 mm broad, the raphe moderately slender, white, with scattered shining raphidophorous cells, exceeding the seed proper slightly at both ends, about 0.1 mm broad; no strophiole is present.

Kanehira originally reduced his *Freycinetia carolinensis* to *F. ponapensis*; however, the glabrous pedicels serve to associate it rather with *F. mariannensis* under this revised treatment.

2. ***Freycinetia ponapensis*** Martelli in Kanehira, in Bot. Mag. Tokyo 48: 129. 1934; Kanehira, Journ. Dept. Agric. Kyushu Imper. Univ. (Enum. Micron. Pl.) 4 (6): 259. 1935; Hosokawa, Trans. Nat. Hist. Soc. Formosa 33: 18. 1943; Glassman, Bishop Mus. Bull. 209: 111. 1952. [Fig. II: 5–9, Pl. III.]

FIGURE III.

1–4. *Freycinetia mariannensis*. Floral details.

- 1: small part of a pistillate spike, showing two flowers, each consisting of a carpel with 2 papillate stigmas, and a few (3–5) staminodes at base. RC=raphidophorous cells. Magnified x 10.
- 2: apex of a carpel, showing the papillae of the stigma, small epidermal cells, and the interior RC. Divisions of scale=0.1 mm.
- 3: small part of a staminate spike, showing stamens; note RC in filaments. Magnification x 10.
- 4: pollen grains to same scale as 2. (All from *Stone* 5206a–b).

5–9. *Freycinetia ponapensis*. Floral details and berry.

- 5: cellular detail from filament margin; to same scale as fig. 2.
- 6: stamens with pistillodes at base, and top view of one pistillode. Magnification x 10.
- 7: berry in profile and top view, with seed, all x 10.
- 8: seed, showing raphe, x 20.
- 9: epidermis of seed, greatly enlarged. (All from *Stone* 5479 and 5480).

F. mariannensis var. *microsyncarpia* Hosokawa, Journ. Jap. Bot. 13: 191. 1937; Kudoa 5: 79. 1937.

Type locality: Ponape; Patapat (*Ledermann* 13245).

Distribution: Ponape and Kusaie.

Specimens examined: PONAPE: Mt. Nanalaut, near summit, June 1957, *Stone* 2034 (BISHOP); Headlands of Pilen-kiepw River, 400 m alt., March 1957, *Stone* 1728 (BISHOP); Mt. Nginani, summit, 2550 ft. alt. Feb. 1965, *Stone* 5479, 5480 (BISHOP, GUAM, UNIV. MALAYA); without locality, Jan. 1915, July 1915, *Koidzumi* s.n. (TOKYO).

KUSAIE: Innemu River, 130 m alt., Dec. 1945, *St. John* 21449 (BISHOP); Limes, near Lele, 100 m alt., May 1957, *Stone* 1903 (BISHOP); Jan. 1941, *Tuyama* (TOKYO).

The *St. John* specimen and *Stone* 5479 are both staminate plants, thus permitting the following description:

Bracts of male inflorescence yellow at base, apically scarlet; spadices 3, on pedicels 2.5–3 cm long and c. 3 mm thick, smooth, cylindric, about 6 cm long and 1 cm thick, the stamens numerous and densely congested, with long slender filaments 3.5–4 mm long; white anthers about 0.7 mm long.

The seeds of this species appear to differ from those of *F. mariannensis*; they are ellipsoid, nearly straight, about 1.2–1.3 mm long, 0.35–0.39 mm broad, raphe 0.1 mm broad, white, barely or not exceeding the embryo, strophiole lacking.

The differences in the seeds, and in the pedical scabridity, serve to differentiate these species, which had been considered identical by Hosokawa. It should be noted that the male inflorescence bracts of all specimens were yellow.

Sect. *Freycinetia*

3. *Freycinetia villalobosii* Martelli in Kanehira, Bot. Mag. Tokyo 48: 128, as *Villalobosensis*. 1934; Kanehira, Bot. Mag. Tokyo 49: 195. 1935; Journ. Dept. Agric. Kyushu Imper. Univ. (Enum. Micron. Pl.) 4 (6): 259. 1935. Nom. emend. H. St. John, Philipp. Journ. Sci. 88 (3): 403. 1960 [Fig. IV: 4–6; Pl. IV.]

Freycinetia almonoguiensis Kanehira, Bot. Mag. Tokyo 49: 186. f. 18. 1935; Journ. Dept. Agric. Kyushu Imper. Univ. (Enum. Micron. Pl.) 4 (6): 259. 1935.

Type locality: Palau Is., Babeldaob Is., in forest at 200–300 m alt., “Urwaldähn. Mittelwald 10–15 m h. mit viel Fiederpalmen, viel Unterholz; . . . Hochkeltternd, Kolben grün, B. glanzend dunkel grün, Rind grau,” Feb. 1914 (*Ledermann* 14323).

The type of Kanehira’s proposed species was from “Palau, Almonogui; coll. Feb. 1933, *Nisida* 2775”. Almonogui (also spelled Arumonogui) is the headland to the north of the large bay or inlet at the mouth of the Gaspan R. in Babeldaob (Babelthuap) Island, on the west coast toward the southern end. It is probably not very far from the locality where *Ledermann* obtained the specimen upon which Martelli based the species description.

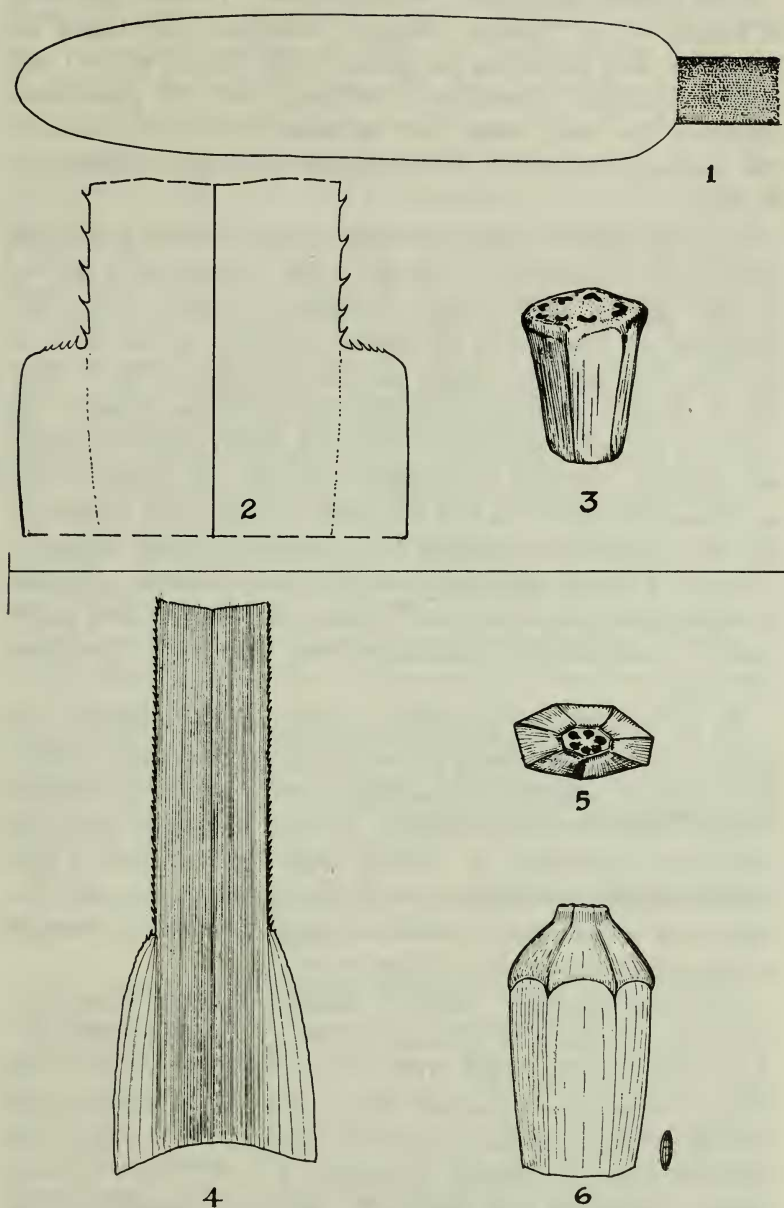


FIGURE IV.

1-3. *Freycinetia boninensis*. 1- outline of syncarp and part of pedicel, natural size. 2- part of leaf base, showing part of blade and part of auricular sheath, natural size. 3- berry, x 5. (From isotype).

4-6. *Freycinetia villalobosii*. 4- base of leaf, showing auricular sheath, natural size. 5- top view of berry, x 5. 6- profile of berry, with seed to scale (but immature), x 5. (From *Hosokawa* 6902).

Distribution: Endemic to Palau Islands, West Caroline Is.

In his original description, Martelli stated: "I named this plant in honour of the Spanish navigator Arrecipes Ruy Lopez de Villalobos, who discovered the groups of the Islands in 1543 and died at Amboina." Somehow he attached the Latin place-name ending to this man's name, and published it as *Villalobosensis*. The necessary correction of orthography was made recently by St. John.

The only apparent differences which might serve to distinguish *Freycinetia almonoguiensis* are the larger syncarps (7.5 cm vs. 10 cm); and an alleged slight difference in leaf-tip shape. Not mentioned by Kanehira is the pedicel scabridity or lack of it; in his figure, the pedicels appear smooth and glabrous. In *F. villalobosii*, there is a minute scabridity distally on the pedicels. One specimen studied (*Takamatsu* 1548, cited below) does have glabrous pedicels. Certainly the syncarp sizes are too similar for any significant difference; the leaf tip shape does not seem different at all; and the pedicel scabridity is a somewhat variable character. All told, it seems difficult to consider the available specimens as representing more than one species, and thus I have united them; a viewpoint in concordance with that of T. Hosokawa (in herb.).

On the other hand, *Freycinetia villalobosii* needs further comparison with certain species of the Philippines (the nearest Malaysian land area, using the term Malaysian in the sense of van Steenis). Martelli mentioned the similarity of such Philippine species as *Freycinetia negrosensis*, *F. superba*, and some of Elmer's later, unvalidated species. It remains to be determined whether the Palau form is an endemic species (as does appear likely) or if it may be a Micronesian outlier of a Philippine species.

Specimens examined: PALAU: Babeldaob Island; Almonogui, Feb. 1933, *S. Nisida* 2775 (TOKYO, isotype); Aimiriik (Aimelik), July 1933, *Kanehira* 2366 (TOKYO); Garamiscan, or Almiokan, River, swamp-forest, *Fosberg* 25729 (US); Mt. Luisalumonogui (=Almonogui), *Hosokawa* 6902 (A, BISHOP, TAIWAN); near Ngaldok Lake, in thickets, *Hosokawa* 9290 (TAIWAN); Garamsumao, *Takamatsu* 1548 (BISHOP); Banks of Garamiscan River, observed only, Jan. 1963, *Stone*; Garamiscan, Sept. 1937, *Tuyama*, (TOKYO).

1.6. Preliminary studies on 'leaf spectrum' series in *Freycinetia*. [Fig. II.]

As pointed out by Melville (Proc. Linn. Soc. Lond. 164: 173-181. 1953) a sequence of leaves in ontogeny, follows a characteristic pattern, which may be termed the leaf spectrum. As an example,

selected leaves from *Freycinetia mariannensis* are shown in Fig. II, beginning with the first foliar organ produced on the lateral shoot emergent immediately below an infructescence. This has on occasion been called a "vegetative bract". It differs, as do also to a lessening extent the subsequent organs (Fig II. 2-9), from fully developed foliage leaves in several major features; it is unarmed (as are nos. 2-5); it is much shorter (as are nos. 2-9); it lacks the characteristic auricles (as do nos. 2-6, although in nos. 5 and 6 they are partially developed); it has a central, ventral longitudinal channel, the result of its being pressed closely against the stem which terminates in an infructescence, and this channel is thickly ridged on both sides; its midrib is inconspicuous (this is also true of no. 2); and it is considerably thicker, especially at the base, than foliage leaves. The spectrum shown here would be continued by an organ which, although with a blade not much longer than no. 9, would have to be considered a mature foliage leaf.

Since in the Pandanaceae there is also a continuous series of organs from foliage leaves to inflorescence bracts, it may be necessary to include the latter in the leaf spectrum. Only a few species, in both *Pandanus* and *Freycinetia*, produce what may be termed a lateral inflorescence. This is a morphological structure deserving much more intensive study. In some *Freycinetiae*, both these 'lateral' and the more common 'terminal' inflorescences are produced by the same plant. In 'lateral' inflorescences the foliage leaf stage is omitted, the transition being from the "vegetative tract" directly to the "inflorescence bract".

A study of leaf spectra of various species is planned as living plants are encountered in the field.

1.7. A note on *Freycinetia boninensis* Nakai. [Fig. IV: 1.3.]

Previously published accounts of this species failed to give a clear idea of the auricles, which have proved to be necessary in the taxonomy of the genus. During a short study visit at the Department of Botany, University of Tokyo, I was enabled, through the courtesy of Prof. Hiroshi Hara and Dr. Y. Kimura, to study material of this species. The following notes and accompanying figures partly clarify the morphology of this species.

Freycinetia boninensis (Nakai) Nakai, Journ. Jap. Bot. 11: 153. 1935.

Type locality: Bonin Is.

First described as a variety of *F. formosana*, this species is very similar to Formosan material, but a critical review of both species is still required. The following notes add to available information concerning the Bonin Is. plant:

Leaves upwards of a meter in length; at base stoutly toothed on the margins; the apex caudate-flagellate, toothed; but intervening middle margins unarmed. Syncarps 3 or more per inflorescence on minutely scabridulous peduncles, the scabridity on all the surfaces and along the whole length of the peduncle. Bracts bright red-orange. Stigmas 4–8, or rarely 9–10, per berry.

The syncarps reach a length of 9.5 cm, but perfectly mature ones have not been seen; the diameter is about 1.8 cm.

Figure IV: 1–3 show auricles, syncarp, and berry.

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Plate I.

Freycinetia mariannensis. A fruiting specimen, in riverine forest along the Ugum River, Guam. (Photo: B. C. Stone).

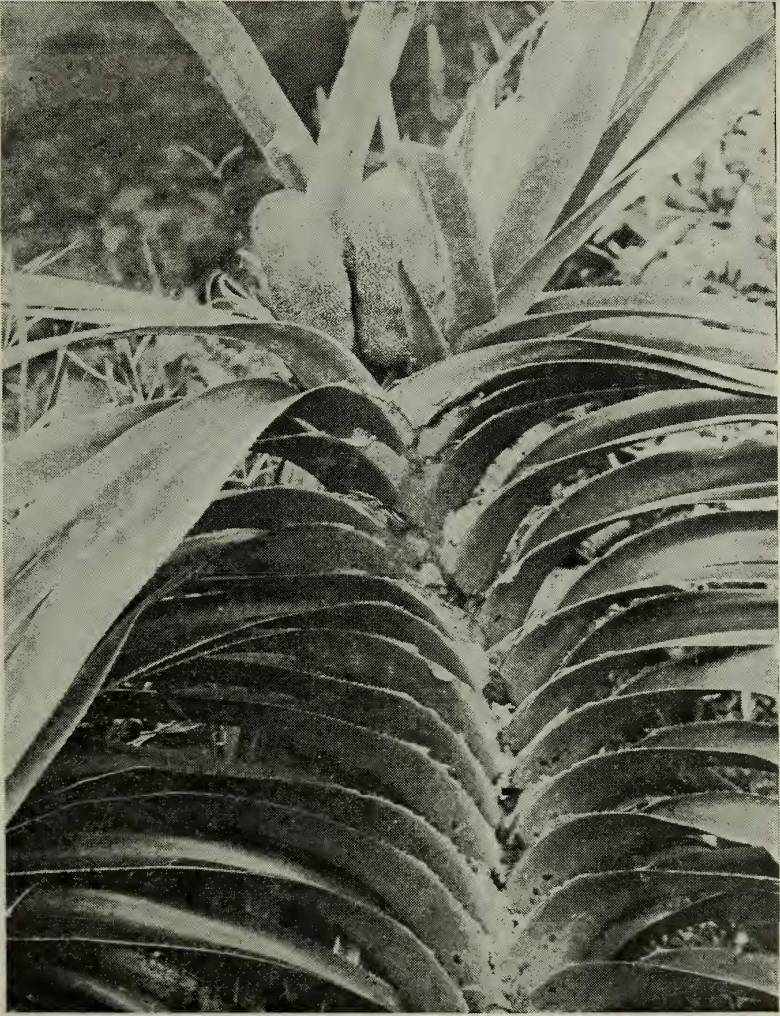


Plate III.

Freycinetia ponapensis Martelli, in mossy forest at the summit of Mt. Nginani, Ponape, alt. 2550 ft.; ripe syncarps red. (Stone 5480).

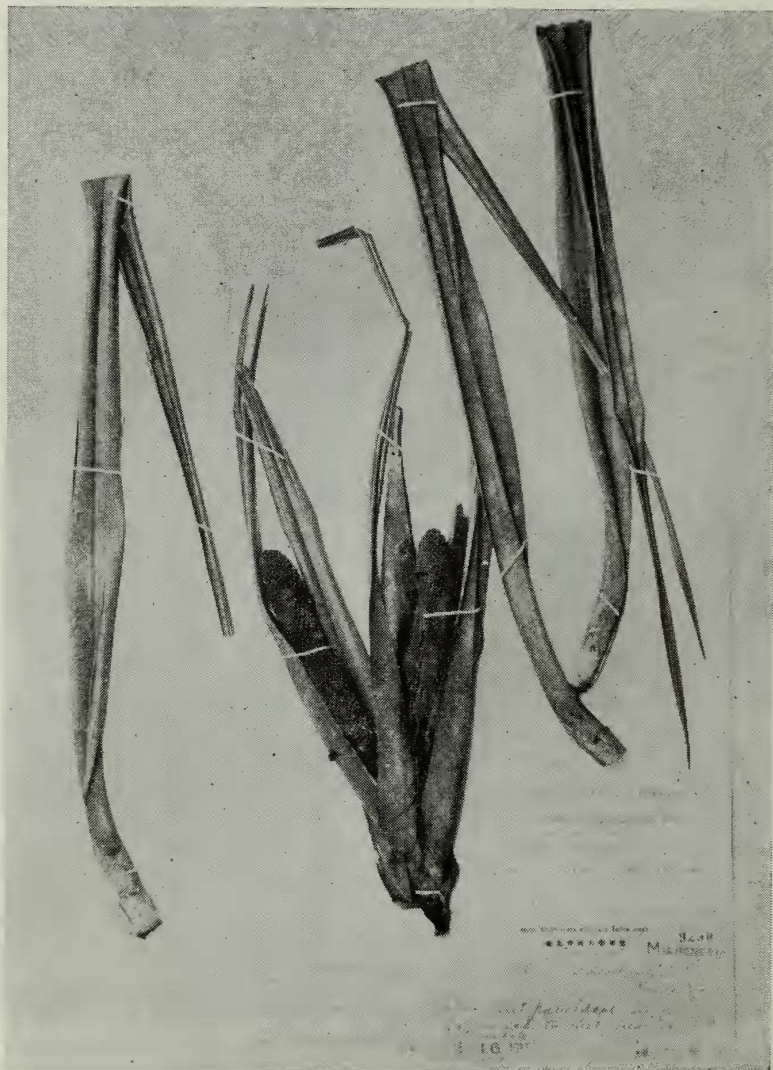


Plate IV.

Freycinetia villalobosii Martelli emend. St. John. Palau (Hosokawa 9290).